

AD7984	18 位、1.33 MSPS PulSAR® 7.0 mW ADC
ADR435	5.0 V超低噪声XFET® 基准电压源
ADA4941-1	单电源、差分 18 位 ADC 驱动器

采用差分 PulSAR ADC AD7984 转换单端信号

电路功能与优势

许多应用都要求通过高分辨率、差分输入ADC来转换单端模拟信号, 无论是双极性还是单极性信号。本直流耦合电路可将单端输入信号转换为差分信号, 适合驱动PulSAR系列ADC中的 18 位、1.33 MSPS器件AD7984。该电路采用单端转差分驱动器ADA4941-1 和超低噪声 5.0 V基准电压源ADR435, 可以接受许多类型的单端输入信号, 包括高压至低压范围内的双极性或单极性信号。整个电路均保持直接耦合。如果需要重点考虑电路板空间, 可以采用小封装产品, 图 1所示的所有IC均可提供 3 mm × 3 mm LFCSP或 3 mm × 5 mm MSOP小型封装。

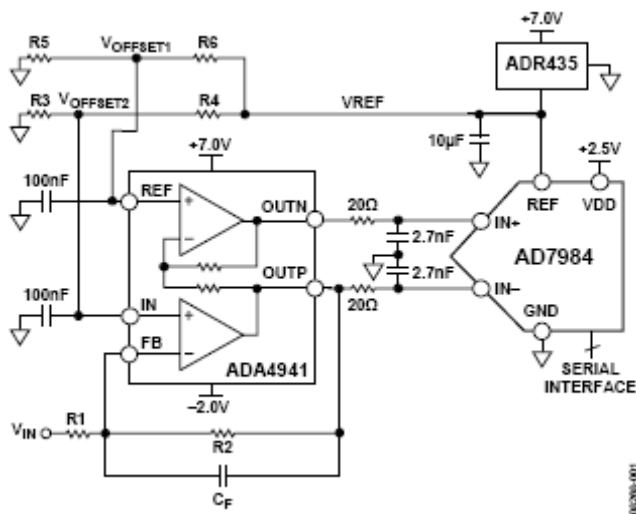


图1. 单端转差分直流耦合驱动器电路（原理示意图）

电路描述

AD7984 的差分输入电压范围由REF引脚上的电压设置。当 $V_{REF} = 5\text{ V}$ 时, 差分输入电压范围为 $\pm V_{REF} = \pm 5\text{ V}$ 。从单端源 V_{IN} 到ADA4941-1 的OUTP的电压增益（或衰减）由R2 与R1 之比设置。R2 与R1 之比应等于 V_{REF} 与输入电压峰峰值 V_{IN} 之比。当单端输入电压峰峰值为 10 V且 $V_{REF} = 5\text{ V}$ 时, R2 与R1 之比应为 0.5。OUTN上的信号为OUTP信号的反相。R1 的绝对值决定电路的输入阻抗。反馈电容 C_F 根据所需的信号带宽选择, 后者约为 $1/(2\pi R2 C_F)$ 。20 Ω 电阻与 2.7 nF 电容构成 3 MHz单极点低通噪声滤波器。

电阻R3 和R4 设置AD7984 的IN-输入端的共模电压。此共模电压值等于 $V_{OFFSET2} \times (1 + R2/R1)$, 其中 $V_{OFFSET2} = V_{REF} \times R3/(R3 + R4)$ 。电阻R5 和R6 设置ADC的IN+输入端的共模电压。此电压等于 $V_{OFFSET1} = V_{REF} \times R5/(R5 + R6)$ 。ADC的共模电压（等于 $V_{OFFSET1}$ ）应接近 $V_{REF}/2$, 这意味着 $R5 = R6$ 。表 1 列出了适合常用输入电压范围的一些标准 1%允许电阻值。

请注意, ADA4941-1 采用+7 V 和-2 V 双电源供电。由于各路输出的摆幅必须达到 0 V 至+5 V, 因此正电源电压应比+5 V 高数百毫伏, 负电源电压应比 0 V 低数百毫伏。本电路选择+7 V 和-2 V 的电源电压。+7 V 电源还能提供足够的裕量, 为 ADR435 供电。只要 AD4941-1 上的绝对最大值总电源电压不超过 12 V, 并且满足 ADR435 的裕量要求, 则也可以使用其它电压。

Rev.A

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表 1. 适合常用输入电压范围的电路值和电压

V_{IN} (V)	$V_{OFFSET1}$ (V)	$V_{OFFSET2}$ (V)	OUTP (V)	OUTN (V)	R1 (k Ω)	R2 (k Ω)	R4(k Ω)	R3, R5, R6 (k Ω)
+20, -20	2.5	2.203	-0.01, 4.96	5.01, 0.04	8.06	1.00	12.70	10.00
+10, -10	2.5	2.000	0.01, 4.99	4.99, 0.01	4.02	1.00	15.0	10.00
+5, -5	2.5	1.667	0.00, 5.00	5.00, 0.00	2.00	1.00	20.0	10.00

AD7984 需要一个+2.5 V V_{DD} 电源以及一个 V_{IO} 电源(图 1未显示)，后者的电压可以在 1.8 V至 5 V之间，取决于I/O逻辑接口电平。

本电路对电源时序不敏感。在瞬间过压条件下，AD7984 输入端可以承受最高 ± 130 mA 的电流。

AD7984 SPI兼容串行接口(图 1未显示)能够利用SDI输入，将几个ADC以菊花链形式连接到单个三线式总线上，并提供一个可选的忙闲指示。采用独立电源 V_{IO} 时，该器件与 1.8V、2.5V、3V和 5V逻辑兼容。

为了使本文所讨论的电路达到理想的性能，必须采用出色的布线、接地和去耦技术。至少应采用四层 PCB：一个接地层、一个电源层和两个信号层。

所有IC电源引脚都必须采用 0.01 μ F至 0.1 μ F低电感、多层陶瓷电容 (MLCC) 对接地层去耦(为简明起见，图 1未显示)，并应遵循“进一步阅读”部分所引用IC的各数据手册中提出的建议。

有关推荐的布线方式和关键器件位置，应参考产品评估板。请在器件的产品主页上查看(见“进一步阅读”部分)。

常见变化

[ADR43x](#)系列基准电压源可以提供与ADC接口的各种不同基准电压值。

进一步阅读

Kester, Walt. 2005. *The Data Conversion Handbook*. Chapters 6 and 7. Analog Devices.

Kester, Walt. 2006. *High Speed System Applications*. Analog Devices. Chapter 2, “Optimizing Data Converter Interfaces.”

MT-031 Tutorial, *Grounding Data Converters and Solving the Mystery of AGND and DGND*. Analog Devices.

MT-035 Tutorial, *Op Amp Inputs, Outputs, Single-Supply, and Rail-to-Rail Issues*. Analog Devices.

MT-074 Tutorial, *Differential Drivers for Precision ADCs*. Analog Devices.

MT-101 Tutorial, *Decoupling Techniques*. Analog Devices. Voltage Reference Wizard Design Tool.

数据手册和评估板

[AD7984 Data Sheet](#).

[AD7984 Evaluation Board](#).

[ADA4941-1 Data Sheet](#).

[ADR435 Data Sheet](#).

修订历史

7/09—Rev. 0 to Rev. A

Updated Format Universal

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